Chapter 5
SINCGARS Planning

5-1. Network Requirements

a. The initial operations plan and unit SOP determine the type of net needed. The network planner must answer the following questions when planning communications support:

- What type of information is to be passed: data, voice, or both?
- Does the unit require communications with users normally not in its network?
- Is the network a common-user or a designated membership net?
- Is retransmission needed to extend the network's range?
- Is an NRI station required?

b. The assistant division signal officer (ADSO) and the unit G3/S3 work together to answer all questions. Once the questions are answered, initial planning and coordinating the network can begin. Many items should become SOP.

5-2. Data Nets

a. The DRA exists in all versions of SINCGARS as an integral part of the radio. The capability for passing different data rates is the DRA in the radios. Without the DRA, the radio can only operate at 16,000 bps. Most tactical data terminals operate at speeds under 4,800 bps, so the DRA is required in all but a few cases. Specific units that require DRA and associated data terminals are - -

- Maneuver units - Maneuver Control System (MCS).
- Field artillery (FA) and data terminal devices.

ADA - Forward area air defense command, control, and intelligence (FAADC2I).

- Military intelligence (MI) - All Source Analysis System (ASAS).

The ADA, FA, and MI data systems will normally be transmitted over the Enhanced Position Location Reporting System (EPLRS) or the Joint Tactical Information Distribution System (JTIDS). In the interim, a limited amount of this traffic can be passed over CNR systems until EPLRS and JTIDS are fully fielded. The only data system not addressed here is the Combat Service Support Control System (CSSCS), the Army's logistics computer system. CSSCS data will normally be transmitted over ACU networks and not over CNR systems. If the mission dictates, however, CSSCS data could be passed via SINCGARS.

b. Brigade and battalion commanders use tactical facsimile devices instead of the radio teletypewriter (RATT) for passing text or overlays. The facsimile currently used is the AN/UXC-7. The AN/UXC-7 can transmit one page of data in 12 seconds at 16 kilobits per second (kbps). SINCGARS and the mobile subscriber radiotelephone terminal (MSRT) are the primary means of transmitting facsimile traffic between users in mobile situations. The advantage of using SINCGARS for facsimile is that a single broadcast can provide the information to several addressees at the same time. Subscribers should transmit facsimile data over wire to the ACU multichamel network when available to reduce electronic signatures.

c. The non-ICOM and ICOM radios can pass data traffic with a DRA installed. The only difference between the two versions is the method of selecting the data rate. The non-ICOM radio has a selector knob on the face of the radio (Figure 5-l). For voice operations, the selector is in the OFF position. When used for data traffic, the operator turns the knob to the correct data rate position (600 to 16,000 bps). The ICOM radio data rate is set through keypad entry of the proper data rate (same as non-ICOM rates).

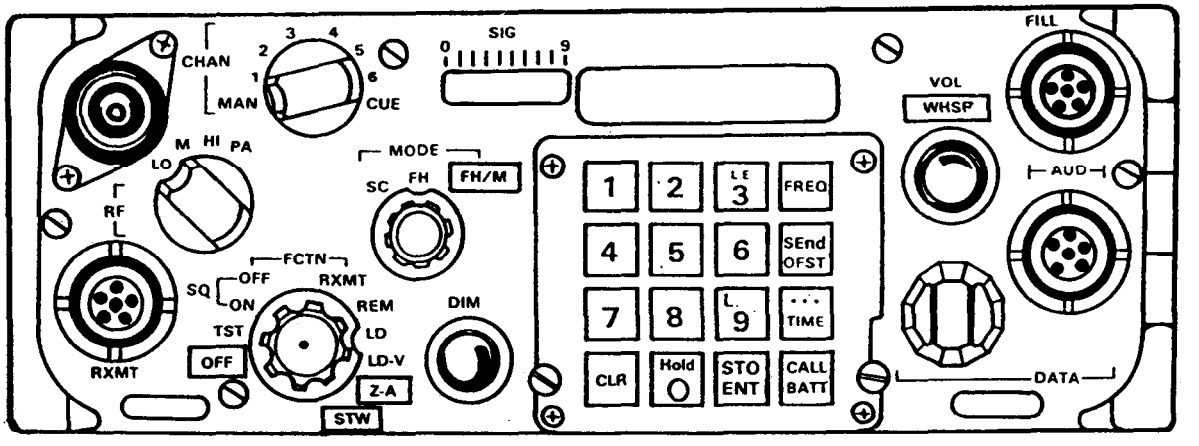

Figure 5-1. Data rate selector--non-ICOM radio.

(1) The non-ICOM radio accepts data rates of 75; 150; 300; 600; 1,200; 2,400; 4,800; and 16,000 bps. The ICOM radio accepts data rates of 600; 1,200; 2,400; 4,800; and 16,000 bps. The radio also provides error correction (for speeds 4,800 bps and below) above the correction done by the

various terminal devices. Although operating at 16,000 bps may be faster, it may not result in transfer of accurate information. The trade-off for speed is longer transmission times for the radio. The data rate should be maintained at the fastest level possible to minimize transmission time and still convey accurate information. The terminal equipment will be the determining factor in most cases.

(2) The data rate selectors have two special data rate positions: AD1 and AD2. These are designed for operation with TACFIRE computers and data terminals. AD1 is used to communicate with other TACFIRE terminals connected to non-SINCGARS radios. ADZ is used for pure SINCGARS radio networks. However, both radios must be equipped with a DRA.

d. When using, the same hopset for voice and data networks, interference from different networks can prevent transferring accurate digital data. If this happens in high-volume communications areas, the ADSO considers allocating a separate hopset to the data network.

e. The SINCGARS radio interfaces with several types of DTE. SINCGARS provides automatic control of the radio transmission when a data device is connected. It disables the voice circuits during data transmissions, preventing voice input from disrupting the data stream. Disconnecting the data device during emergency situations overrides the disable feature. A single cable from the DTE to the radio or mounting adapter connects most DTEs.

(1) The primary data devices used will be the facsimile (UXC-7 or GXC-7A), teletype terminal AN/UGC-74, and the various computer terminals (MCS, AFATDS, ASAS, or FAADC21). All of these devices are cabled in the same manner (Figure 5-2). The only difference between devices is selecting data transmission speeds. To optimize the abilities of the data devices and SINCGARS, the devices should operate at the fastest possible data rate. The radio and DTE error correction abilities should be compared to provide the fastest transmission time and the most accurate transfer of information. Data devices used must be capable of SINCGARS data bit streams.

(2) TACFIRE uses a special configuration and data rate selection. Figure 5-3 shows the physical connections from the computer terminals to the radio. Data device A is associated with RT A and device B with RT B. The data rate selector is set to either ADl for communications with non-SINCGARS radios or AD2 for pure SINCGARS networks. Figure 5-3 shows connections that also apply for the digital message device (DMD) AN/PSG-2. The TACFIRE devices should be set as follows:

- Data rate - 1,200 baud.
- Keytime - 0.7 second.

If the TACFIRE system experiences high error rates, the operators may have to change to 600 baud to improve reliability. TACFIRE data devices may be remoted from the radio using either the AN/GRA-39 or the SRCU (Figure 5-4). The AN/GRA-39 can only be used with TACFIRE and not with other data devices since it can only handle analog signals. The SRCU can be used in all cases.

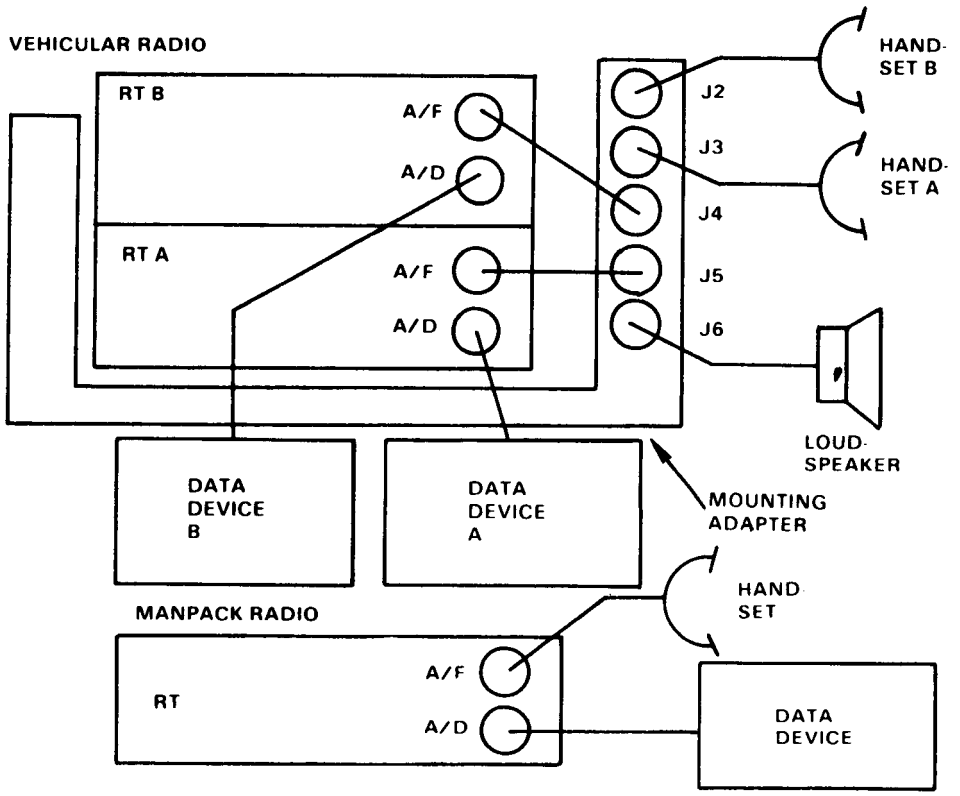

Figure 5-2. Cabling for voice/data operation.

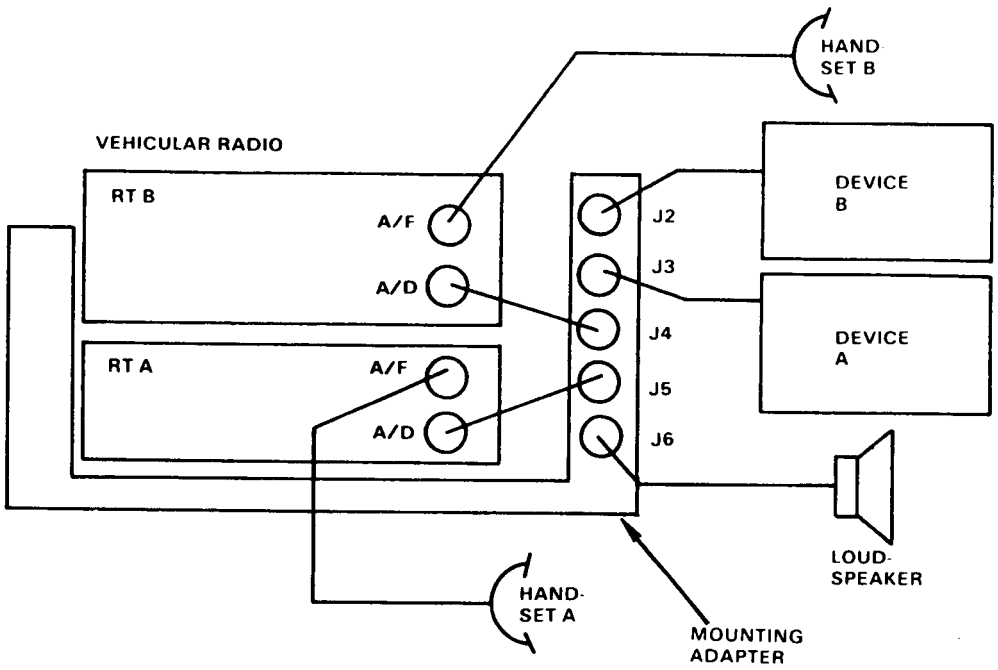

Figure 5-3. Cabling for TACFIRE.

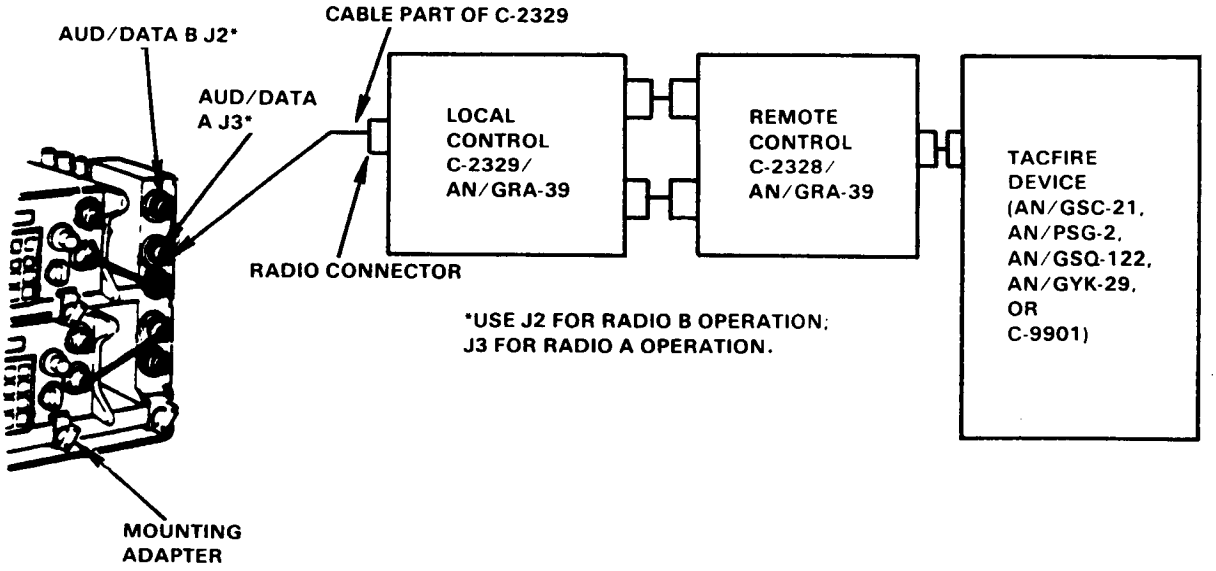

Figure 5-4. Remoting of TACFIRE devices.

5-3. Secure Devices

a. SINCGARS uses two basic devices to provide secure voice communications capability. The non-ICOM radio uses the VINSON KY-57 for ground applications and the KY-58 for airborne configurations. The ICOM radio uses an internal COMSEC module whose encryption format is compatible with current VINSON devices. The devices are compatible provided they are loaded with the same traffic encryption key (TEK).

(1) The VINSON secure device has six preset positions--five for the TEK and one for a key encryption key (KEK). The five TEK positions allow operation in five different secure networks. The KEK allows changing or updating the TEK through over-the-air (by radio transmission) fill.

(2) The ICOM secure module retains one TEK per preset hopset/net identifier and one KEK. The corps signal planning element is responsible for ensuring the TEK is distributed to all units in the corps.

(3) The variables are loaded and updated the same way in both devices. Initial loading is done by the KYK-13. Variables can be updated by a second manual fill or by over-the-air remote fill. The NCS operates the KYX-15 as the control device for network secure variables. In accordance with COMSEC regulations, only the TEK may be transmitted over the air. The KEK must still be physically loaded into either the VINSON or ICOM radio. Encryption variables are controlled through COMSEC channels and are accounted for per TB 380-40.

b. Data input to the radio is interleaved into the radio's digital data stream. The VINSON or ICOM circuits encrypt the data before transmission. However, digital data may be encrypted before inputting the

information to the radio. COMSEC variables must be common for the transmitting and receiving terminals. This is coordinated between the two units passing the information.

5-4. VHF-FM Retransmission Stations

a. The FM retransmission station operates on the command network to which it is subordinate, unless specifically tasked. The primary radio monitors the command/operations network and the secondary provides the retransmission link. Prior planning provides the retransmission station with the appropriate variables for the command network and retransmission network. The unit SOP should direct how the retransmission variables are assigned in accordance with possible alternatives.

b. Frequency planners for the AN/VRC-12 radios were primarily concerned with frequency separation and harmonic interference. Those criteria are still important for SINCGARS but vary for specific system configurations. SINCGARS can perform the. retransmission function three ways. The network--

- Can be set up for standard AN/VRC-12 retransmission--single-channel to single-channel.
- Can be of mixed mode--FH to single-channel or vice versa.
- Can use its full capability of FH to FH.

These options make retransmission flexible in operation. They also increase the prior coordination required before deployment. This ensures all users have access to the retransmission function.

(1) Single-channel to single-channel operation has the same requirements as previous VHF-FM retransmission configurations--10 MHz separation between fl and f2 (Figure 5-5). Physically moving the antennas farther apart or lowering power output lessens the separation in frequency. Table 5-1 shows the relationship between frequency and physical separation. The network NCS must control the retransmission station in regard to changing off the command hopset to ensure continuous communications for the unit.

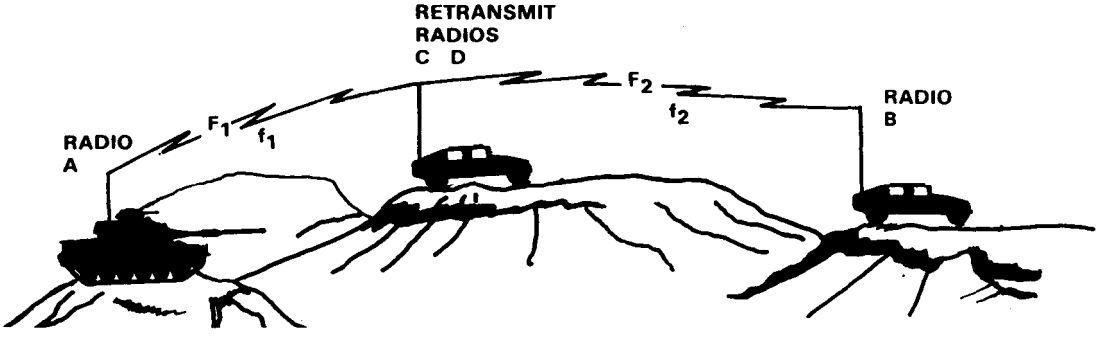

Figure 5-5. Retransmit operation.

Table 5-1. Minimum antenna distance separation.

Minimum frequency separation required	High power separation	PA power separation
10 MHz	5 feet	5 feet
7 MHz	10 feet	60 feet
4 MHz	50 feet	150 feet
2 MHz	200 feet	400 feet
1 MHz	350 feet	800 feet

(2) FH to single-channel operation is the simplest mode to set up and operate. There is no requirement for frequency or physical separation. The single-channel frequency can be part of the hopset used on the FH side of the retransmission but should be an independent frequency if available. This method allows a single-channel radio user access to the FH network in an emergency situation. Continual access to the FH net using this method should be avoided to prevent lessening the ECCM capability of the SINCGARS systems.

(3) FH to FH operation requires at least one of the hopping variables from FH1 to FH2 to be different. Any one or a combination of several variables may change, but the preferred method is with the same hopsets but with different net identifiers for each side of the retransmission.

c. The retransmission station operator functions like the network NCS for the outstation link. In this function, the operator answers all cues, ERF, hopset variables and authenticates net entry. The retransmission operator must ensure the outstation RT is placed in the FH/M mode. This ensures timing on this link is established and maintained.

d. SINCGARS can operate as either a secure or nonsecure retransmission station. The radios automatically pass secure signals even if the retransmission radios are operating nonsecure. However, the retransmission operator cannot monitor the communications unless the secure devices are filled and in the cipher mode. Figures 5-6 and 5-7 show the equipment configurations for nonsecure and secure retransmission. The ICOM radio requires a single cable, the same as the non-ICOM, nonsecure retransmission.

e. The retransmission station should use ground-plane antennas when time permits to extend range at the lowest possible power. When the radios operate in the power amplifier (PA) power setting, at least one radio must use a dismounted antenna for physical separation. Physical separation decreases radio frequency (RF) interference. The antenna must be a broadband antenna such as the OE-254 or the OE-303.

f. SINCGARS radios are compatible with noise, tone, and digital squelch signals at all times. No special planning is required for the different squelch systems on the various radios in the network.

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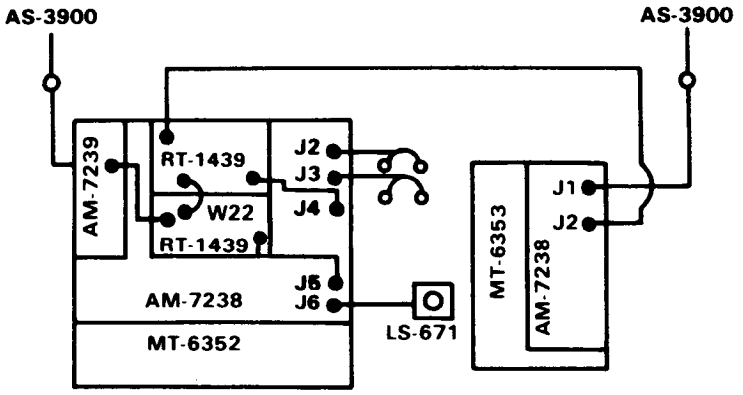


Figure 5-6. SINCGARS nonsecure retransmission.

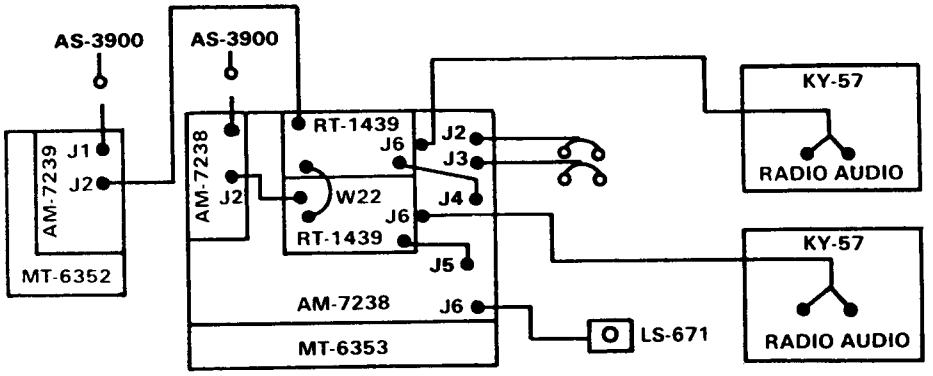


Figure 5-7. SINCGARS (non-ICOM) secure retransmission.

5-5. NRI Systems

a. NRI provides a SINCGARS subscriber access to the ACU multichannel system or a telephone user access to the CNR network. There are 44 total NRI systems in the notional five-division corps. Although each LENS and SENS contains the NRI mounting assembly, current fielding plans for MSE to place 4 NRI systems in the division signal battalion and 24 in the corps signal brigade (based on one per node center (NC)). The division's equipment is presently located in the SENS shelters, which are colocated with the maneuver brigade CP and the engineer battalion CP, or in the division support command (DISCOM) LENS shelter. These locations are tentative, based on mission requirements to provide the best support in the forward areas. The corps NRI systems deploy with the LENS or SENS throughout the corps area.

b. NRI systems operate in the FH mode to the maximum extent possible to minimize the possibility of direction finding of the CP or switch locations. Deployment of the corps NRI systems (including the division assets) is based on an area concept.

(1) Each NRI station establishes its own hopping variables and acts as an NCS. The NRI systems numbered NRI 1, 2, and 3 are associated with the maneuver brigades. NRI 4 can be located with any switch in the division area depending on the mission. The NCS function for the NRI station is to provide a central time reference. It also allows access using the cue frequency for all NRI subscribers. The term "habitual association" means a particular unit deploying in support of another. In this case, it means the association of a particular NRI number to a unit area and not a signal unit to a combat unit. The first brigade area uses the call sign and telephone directory number for NRI 1 and so on across the divisional areas. The numbering plan for the NRI systems is the same for all divisions. This scheme allows any radio or telephone subscriber to easily identify the NRI device he needs to access for a call.

(2) The corps area is also divided into communication zones that reflect an extension of the divisional boundaries to the corps rear boundary (Figure 5-8). Each NRI station is an NCS and operates on its own set of hopping variables. The NRI systems are numbered sequentially 1 through 5 and are deployed left to right across that NRI zone. Again, the subscriber can easily identify the NRI device to access.

(3) The hopsets used in the NRI zones alternate from division to division and from forward to rear throughout the corps area. Figure 5-8 also shows the layout of the frequency hopset reuse plan with the NRI zone configuration. This allows the network to maintain synchronization and simplifies subscriber access to the NRI system.

c. To access the NRI system, users must have the required FH variables of the NRI radio, or they must contact the station on the cue frequency. The unit BSO and the S3 determine the need for access to the NRI system when establishing SOPs. Subscribers who require recurring access to the NRI system should store the NRI hopset in FH preset position number 5. If the NRI hopset is not stored in a preset, the subscriber may still access the system by either manually loading the variables from a fill device by requesting a time hack or by using the cue frequency and requesting a transfer of the hopping variables from the NRI operator. The cue frequency is stored in single-channel position number 1.

d. Unlike previous NRI systems, the new equipment can provide secure NRI access end to end. VINSON-type devices secure the SINCGARS radio link. The KY-90 and the KY-68 digital subscriber voice terminal (DSVT) or the physical security of the TA-1035 secures the wire link inside the MSE system. The TEK for all VINSON-type secure devices will be common throughout the corps so that secure communication is available to the greatest number of subscribers. The corps G3/G6 coordinates distribution of the key list or variables to all units in the corps. Each network has a unique KEK and still provides selective remote keying of the secure devices if a unit is captured. If a radio user does not have the proper COMSEC key, the call may be completed in the nonsecure mode. However, the NRI operator must inform both parties that the call is nonsecure and that proper radiotelephone operator (RATELO) procedures must be followed.

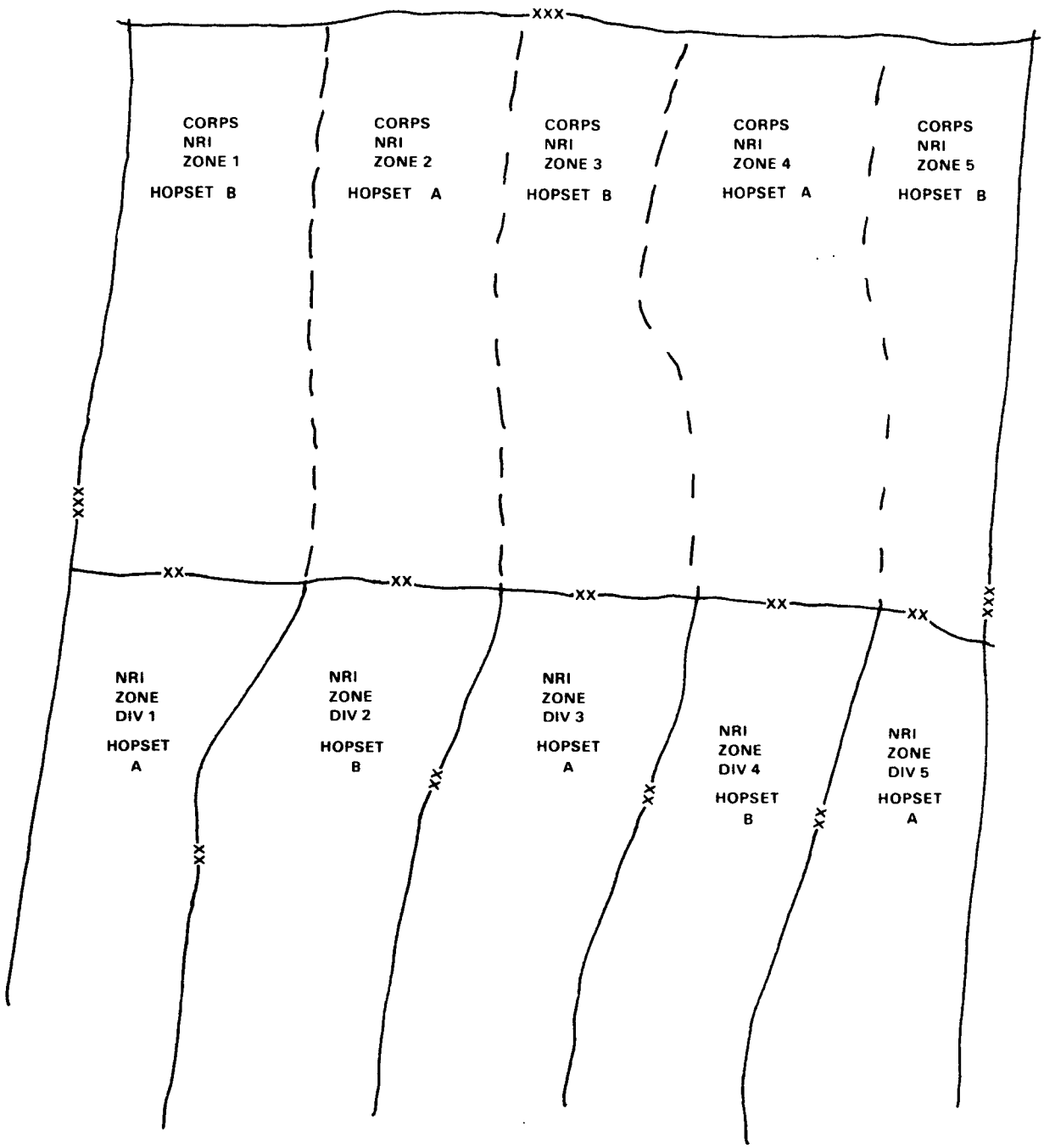


Figure 5-8. NRI zones and hopset use for five-division corps.

e. The following subparagraphs outline procedures for placing NRI calls from both the radio and telephone sides of the system. The NRI operator controls and monitors all calls to ensure the subscribers use proper RATELO procedures.

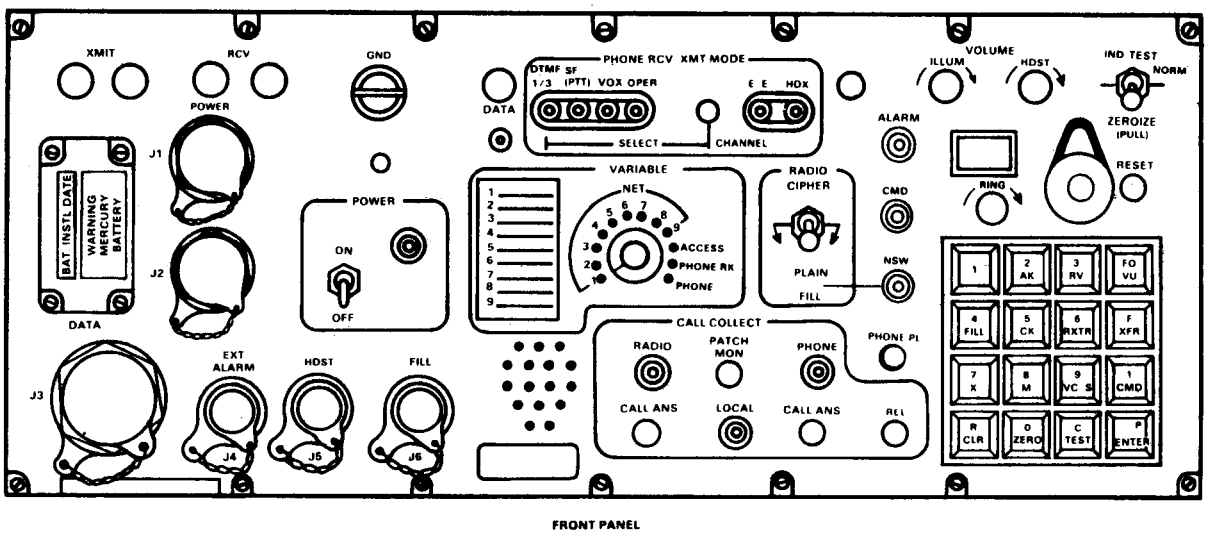
(1) A CNR user calling from a radio into the NRI system switches to the NRI hopset or cue frequency and calls the NRI closest to his location. If the call is on the cue frequency, the NRI operator determines if the caller is authorized use by authentication. If the caller authenticates correctly, the operator transfers the NRI hopping variables to the caller and continues the call in the FH mode. The call should not be made in the single-channel mode. The caller identifies the wire subscriber to the NRI operator by radio call sign or telephone number. The NRI operator looks up the individual in the telephone directory. Then he calls the telephone number of the intended recipient and transfers control of the call to the two users.

(2) The telephone user desiring to call a radio subscriber looks up the telephone number of that subscriber's NRI system. The user tells the NRI operator who he wants to contact and, if possible, in what network the radio is operating. The NRI operator notifies the radio subscriber on the subscriber's network cue frequency. The radio subscriber tunes the radio to the NRI hopset to complete the call. If necessary, the NRI operator will transfer the NRI hopping variables to the radio subscriber.

f. The KY-90 and the C-6709 are currently used for NRI systems. Both have similar functions, but the C-6709 is an analog device and cannot be secured over the wire line to the switchboard.

(1) The KY-90 (Figure 5-9) is the digital interface device designed for MSE and TRI-TAC digital switches. The KY-90 appears as a KY-68 DSVT to the switched network and operates in the network as a secure terminal. This provides a secure system from the telephone user to the NRI system operator. The KY-90 also stores up to nine TEKs compatible with VINSON-type devices that secure the radio link of the complete circuit. This provides an end-to-end secure (either encrypted or physically secure) circuit for the user placing a call either into or out of the system. Figure 5-10 shows the equipment hookup for the KY-90 to SINCGARS. It should be noted that only voice traffic is possible when using the KY-90 and the MSE system.

(2) The C-6709 (Figure 5-11) is the analog interface device used with analog switches or with digital switches equipped with analog conversion cards. The radio link can be secured by VINSON-type devices, but the wire line must be kept within a controlled area to secure the wire. The switchboard treats the C-6709 as a four-wire telephone subscriber similar to the TA-341 telephone. Figure 5-12 shows the equipment hookup' for the C-6709 to SINCGARS.



FRONT PANEL

Figure 5-9. Secure digital NRI unit KY-90.

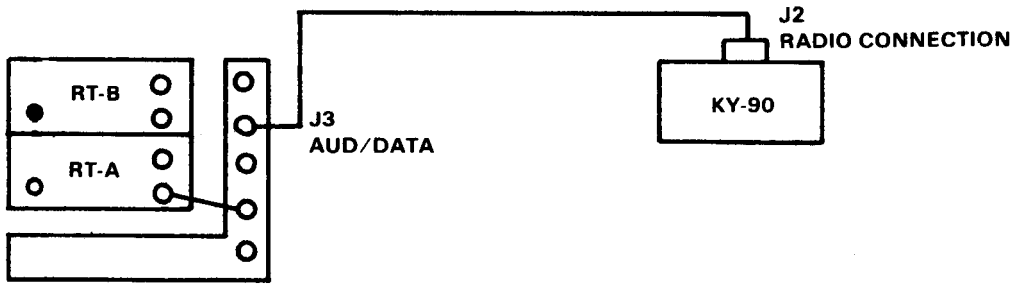


Figure 5-10. Equipment hookup--KY-90 to SINCGARS.

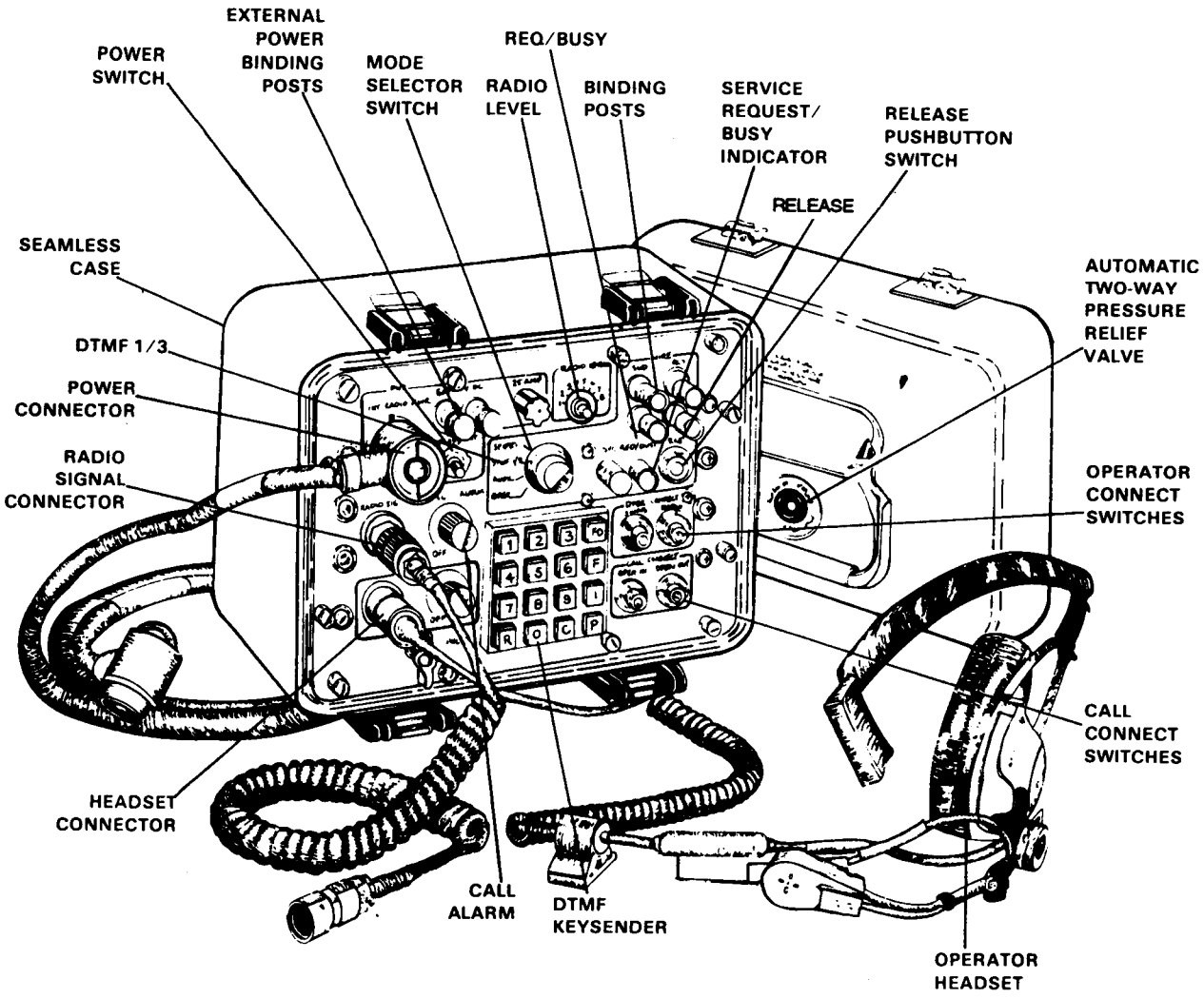
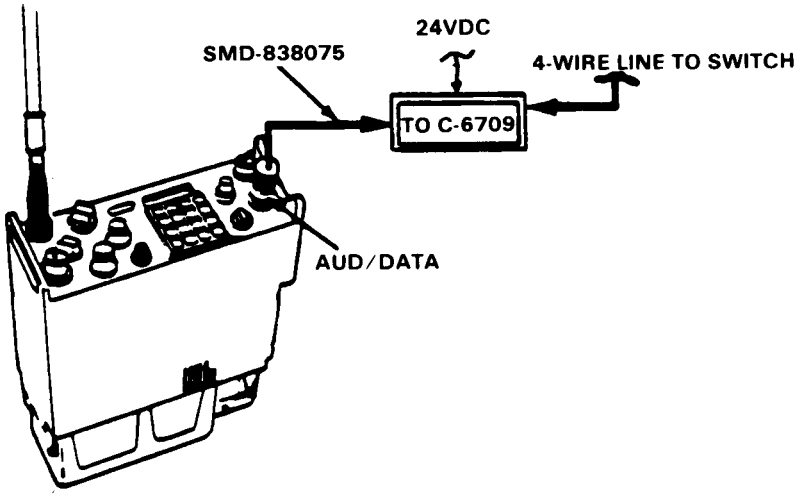


Figure 5-11. Analog interface device C-6709.



NOTE:
Cable from AUD/DATA to C-6709 is for signals only. SINCGARS does not provide power for the C-6709.

Figure 5-12. Equipment hookup--C-6709 to SINCGARS.